1/PRTS

Pressure Control Valve

The present invention relates to a pressure control valve, in particular for electrohydraulic brake systems according to the preamble of patent claim 1.

DE 198 30 464 A1 discloses a pressure control valve of this type which includes a valve member arranged in a valve housing and a sensor element for determining the fluid pressure that prevails in the valve housing. The fluid pressure is determined directly by the arrangement of the sensor element in the valve housing, to what end corresponding structural provisions are necessary which also affect the overall dimensions of the pressure control valve. Due to the relatively high operating pressure, a correspondingly expensive sensor system is generally required which is permanently exposed to high pressures.

In view of the above, an object of the present invention is to configure a pressure control valve of the type initially referred to in such a way that a low-cost determination of the hydraulic pressure that acts in the pressure control valve is ensured by entailing relatively low structural and functional efforts.

According to the present invention, this object is achieved for a pressure control valve of the indicated type by the characterizing features of patent claim 1.

Further features, advantages, and possible applications of the present invention can be taken in the following from the description of two embodiments by making reference to Figures 1 and 2.

In the drawing,

Figure 1 is a basic circuit diagram of the sensor assembly that is essential to the present invention.

Figure 2 shows an embodiment for the design of a sensor element for the assembly presented in Figure 1.

Figure 1 shows a simplified view of a pressure control valve 9 which is arranged in a block-shaped valve-accommodating member 14 and is especially suited for use in electrohydraulic brake systems. The pressure control valve 9 accommodates in a valve housing 1 a valve member which is adapted to close or open the pressure fluid channels disposed in the valve accommodating member 14 by way of the electromagnetic actuation of a valve coil 11.

Further, a sensor element 2 is arranged above the valve coil 11 on the outside of the dome-shaped valve sleeve area. Sensor element 2 is used to determine the fluid pressure which prevails in the pressure control valve 9. According to the present invention, the fluid pressure in the valve housing 1 is indirectly sensed by the sensor element 2 by way of the measurement of the deformation of the valve housing. As regards the design of the sensor element 2, it becomes apparent from Figure 1 that a wire strain gauge 5 is fitted to the dome-shaped portion of the valve housing 1 and, in conjunction with a gauge ring 6 and reference ring 7 that will be illustrated in the following in Figure 2, forms a measuring element 4 which, by way of exciter ring 8, senses a signal representative of the deformation of the valve housing in the event of hydraulic pressure variation and transforms it into a pressure signal by way of an appropriate sensing and evaluating circuit.

According to Figure 1, the signal-receiving and exciter assembly 3 is mounted directly on a cover 10 which also accommodates the controlling and/or regulating electronics 13 that is required for the operation of the pressure control valve 9. Electronics 13 is connected electrically and also mechanically by way of the electric contacts 12 of the valve coil 11. Valve coil 11, the controlling and/or regulating electronics 13, and the signal-receiving and exciter assembly 3 are thus combined to form a prefabricated assembly in the cover 10. Cover 10 is seated on the valve-accommodating member 14 that carries the pressure control valve 9. It can be seen in the drawing of Figure 1 that the sensor element 2 is isolated by an air gap from the signal-receiving and exciter assembly 3 so that a non-contact signal transmission occurs between a measuring element 4, that is integrated in the sensor element 2 and fitted to the pressure control valve 9, and the signal-receiving and exciter assembly 3 in which the sensor signal characterizing the valve housing deformation is transformed into a pressure signal. Therefore, it is proposed for the operation of the sensor element 2 that the signal-receiving and exciter assembly 3 causes induction of an electric voltage in a receiving circuit integrated in the sensor element 2, the said voltage permitting the operation of the measuring element 4 associated with the sensor element 2.

Upon request or requirement, the sensor element 2 and the signal-receiving and exciter assembly 3 may be provided with a corresponding signal amplifying and/or compensating circuit in order to stabilize the quality of signal transmission.

With a view to ensuring a precisest possible signal determination and signal transmission with respect to possible air gap tolerances between the sensor element 2 and the signal-receiving and exciter assembly 3, it is disclosed that the

sensor element 2 is not only equipped with a measuring element 4 but with a suitable reference circuit in addition.

A specific embodiment which ensures a stable signal transmission quality irrespective of the size of the air gap that exists between the valve dome and the cover 10 shall be represented in the following by way of Figure 2.

Figure 2 shows an expedient design of the sensor element 2 which is hinted at in Figure 1 already. The sensor element 2 is shown in a top view on the valve dome of the valve housing 1. The valve dome represents the area of the pressure control valve 9 which is sensitive to deformation under the effect of the hydraulic pressure.

The sensor element 2 which is aligned concentrically to the valve axis comprises in detail a reference ring 7 and a gauge ring 6 connected to a wire strain gauge 5, the said parts being mounted onto the thin-walled sleeve area of the valve housing 1. Exciter ring 8 is arranged equally coaxially relative to the sensor element 2 and spaced from the pressure control valve 9 by the air gap. The exciter ring 8 along with the signal-receiving and exciter assembly 3 forms a construction unit which is arranged in the cover 10 spaced from the pressure control valve 9. In the exciter ring 8, the signal-receiving and exciter assembly 3 induces a voltage which is conducted through the reference ring 7 to a certain extent and through the gauge ring 6 to the wire strain gauge 5 to another extent. The reference ring 7 and the gauge ring 6, in turn, induce magnetic fields which are received by way of the exciter ring 8. The field induction in the exciter ring 8 causes the circulation of an alternating current through the ring. Induced current also passes through the gauge ring 6 and reference ring 7 so that the thus produced magnetic fields of the rings 6, 7 can be sensed by means of appropriate sensor elements, for

example, by means of Hall elements. Consequently, two sensor signals are available that allow to determine the deformation of the valve housing 1 and, thus, the pressure prevailing in the pressure control valve 9.

An arrangement of this type is suited especially for electrohydraulic brake systems necessitating a large number of sensor elements 2 which may be accommodated between the valve-accommodating member 14 and a cover 10 that includes the controlling and regulating electronics 13 and is seated on the valve-accommodating member 14. Another case of application is for traction slip and driving dynamics control systems in automotive vehicle brake systems.

List of Reference Numerals:

1	valve housing
2	sensor element
3	signal-receiving and exciter assembly
4	measuring element
5	wire strain gauge
6	gauge ring
7	reference ring
8	exciter ring
9	pressure control valve
10	cover
11	valve coil
12	contact
13	controlling and/or regulating electronics
14	valve-accommodating member